# IMMERSIBLE DIVER'S MICROPHONE

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NOTICE

The Government-owned invention described herein is available for licensing.

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IMMERSIBLE DIVER'S MICROPHONE

ABSTRACT OF INVENTION DISCLOSURE

This application discloses an invention including a ceramic gradient microphone insensitive to mask cavity acoustics, essentially flat in pressure response to 10,000 Hz for use in deep submergence helium atmospheres, and capable of withstanding compression, decompression and intermittent flooding. In essence, there is provided a microphone having a diaphragm mounted to a bimorph ring and includes unique construction to provide the frequency response and gradient characteristics, plus drainage characteristics.

Deep submergence microphones usable with helium atmospheres are required by divers operating under increased pressure conditions. Using helium, an inert gas, instead of nitrogen, has the advantage that bubbles will not develop in the blood stream of the diver which cause "bends" and other problems associated with dissolved nitrogen in the blood stream. Many microphones have been tried in the environmental conditions of a diving mask. Among those are magnetic microphones which require close clearances between moving parts. When a mask is flooded, sea water penetrates into these spaces, causing corrosion and, in time, an accumulation of salt crystals. Setting the first mechanical element of the diaphragm and piezoelectric ceramic bimorph ring to approximately 20,000Hz provides smooth response in the speech range, extending to 10,000Hz or higher in helium-oxygen atmospheres, without any need for acoustic compensation for the resonance. Such compensation would be altered and degraded by changes in atmospheric pressure and composition. The relatively low sensitivity associated with the 20,000Hz resonance is made up for by solid state amplifier circuitry.

With the construction provided by this invention, there are no

moving parts requiring close clearances. The protective coverplates are not only perforated but are separated from the housing sufficiently to form 1/10 inch, self-draining slots at their peripheries. The perforations toward the diver's lips may be cleared by blowing. If any water remains temporarily in the perforation on the far side, there is only a minor deterioration of performance.

A pressure gradient microphone placed in a diver's helmet close to the lips is insensitive to the acoustics of the diving mask cavity. The diaphragm of a gradient microphone is open to sound on both sides and responds to a pressure difference. The term noise-cancelling microphone is frequently used, as the sensitivity is greater for the approximately spherical waves emerging from the lips than for the more nearly plane waves characteristic of ambient noise.

It is an objective of this invention to provide an improved immersible diver's microphone capable of rapid drainage and immune to deterioration of performance due to deposit of salt crystals.

It is still a further objective of this invention to provide an improved gradient microphone utilizing spherical diaphragm coupled to a bimorph ring affixed to a housing and mounted in a central cavity therein and having perforated end plates including peripheral slots and a plurality of small circular openings.

Therefore, it is an objective of this invention to provide an improved immersible diver's microphone comprising, a housing member having a hollow central portion and having first and second ends, a ceramic bimorph member disposed in the hollow portion, an epoxy affixing the ring within the housing, the ring being substantially normal to the longitudinal axis of the housing, a diaphragm affixed to the ring, first and second end plates affixed to the housing individually having leg members positioning the end plates at distance from the housing member for providing drainage from the

central portion, electrical connecting means attached to the bimorph ring and apreamplifier circuit coupled to the electrical connecting means for connecting electrical signals generated by the ring.

Yet a further objective of this invention is to provide an improved gradient microphone with protective end plates mounted 0.1 inch from the housing to allow for rapid drainage due to flooding.

Other objects, advantages and novel features of the invention will become apparent from the following detailed description of the invention when considered in conjunction with the accompanying drawings wherein:

Figure 1 is a front view of one embodiment of the invention and

Figure 2 is a cross sectional view along lines AA in Figure 1.

Figure 1 wherein the immersible microphone is designated generally as 10 has an electrical connection 11 coupled to microphone 10. A solid state circuit can be mounted in the expanded part 12 or in the housing, part 15, but does not form a part of this invention and is not shown.

The microphone itself, consists of a housing member 15 having extending therethru along longitudinal axis 16, a hollow central portion 17. Disposed along the axis 16 is a ceramic bimorph ring 18 of a three sandwich layer construction. A kapton diaphragm 20 is affixed to an inner edge of the ring 18 and has electrical connections 24 and 23 connected thereto for conducting an electrical signal to an external circuit not shown. Ring 18 is affixed to housing 15 by an epoxy compound 25 that also holds a support ring 26.

The support ring 26 has a recessed portion 27 designed to receive legs 28 and 29 of cover plate 30. Housing 15 also has a recessed portion 32 designed to receive support legs 33 and 34 of a second cover plate 35. Each cover plate is affixed to the housing 15 thru

screws, two of which 40 and 41 are shown in Figure 1. The cover plate 30 and 35 individually include a plurality of holes designed as 45 for the purpose of allowing the sound waves to reach the microphone's central portion.

The cover plates are individually spaced approximately the same distance from the housing to provide for drainage in the event the microphone is flooded.

In one successful embodiment of the invention the gradient microphone was tested in atmospheres of 97.5 percent helium at a simulated depth of 650 feet. Listening tests and Sonagrams showed no difference in the helium speech due to any effect of mask cavity as opposed to the open boom mount. Comparisons of Sonagrams for helium speech with those for sea level speech showed a simple proportional upward shift of formant frequencies (resonance frequencies of the vocal tract) of approximately 2.9. There was no indication of the nonlinear shift (first formants more than the second) frequently reported in the literature as a result of the pressures of deep submergence.

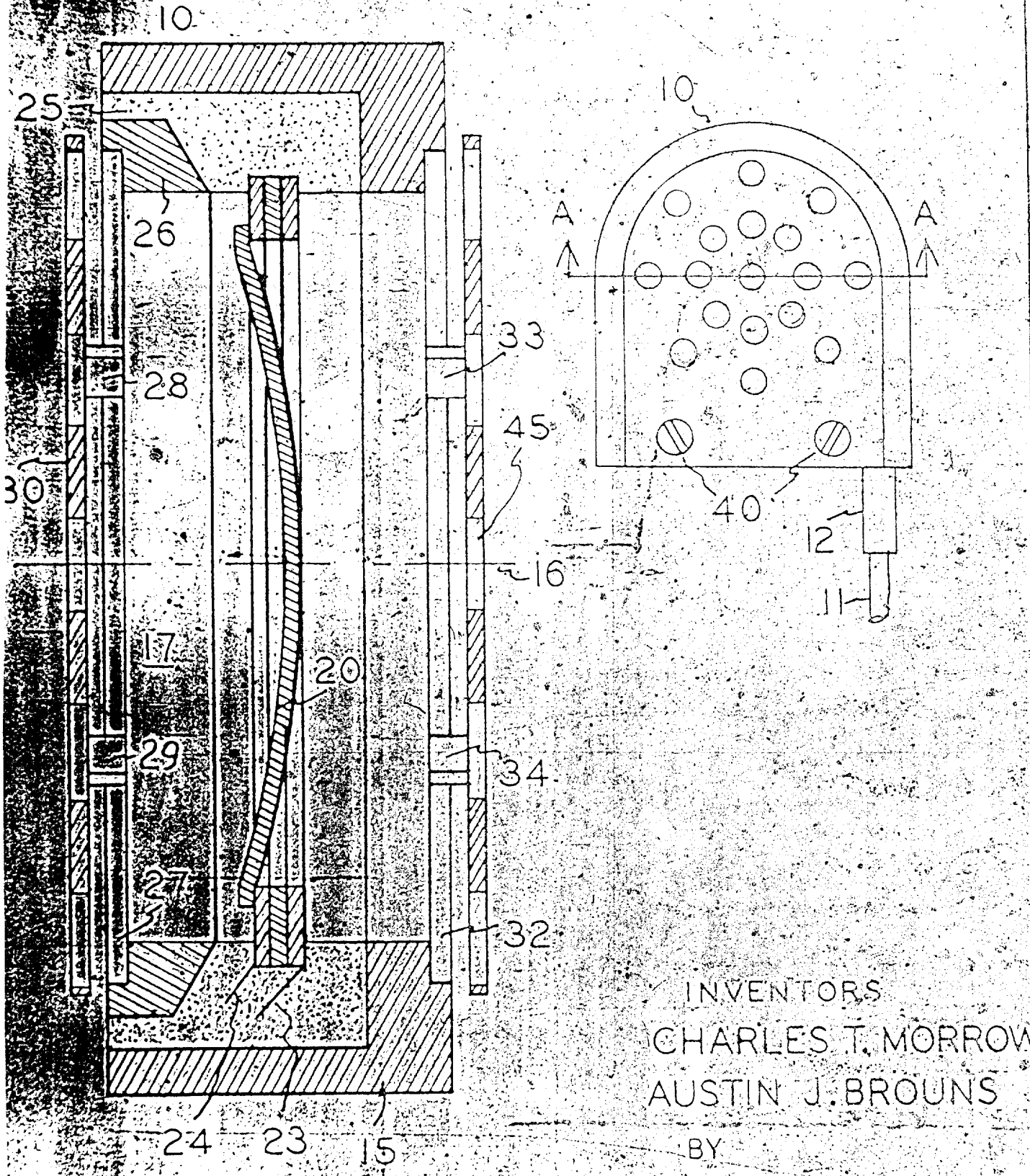
One of the initial problems overcome by this design was that of helium penetration from extreme depth and potential decomposition from decompression and salt water immersion. In the construction of the microphone the potting compound was degassed in a vacuum before using, and filling operations included several evacuations and recompressions to help avoid trapping any gas.

Experiments showed that water would drain readily under its own weight thru a slit less than one tenth of an inch in width, therefore, the protective cover plate for the diaphragm may be separated from the microphone body this tenth of an inch for successful operation. However, coating the inside of the cover plates with a water repellent may permit the slots to be less than one tenth of an

inch and still let water drain off without difficulty. The one tenth of an inch is not a critical dimension but is an optimum design parameter.

One successful form of epoxy used was Minnesota Mining and Manufacturing Scotch-cast resin No. 8 with a trace of Plastic Molders Supply PMS No. 4640 black dye.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that [redacted] the invention may be practiced otherwise than as specifically described.

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